

CHAPTER 7

The case of Michael Michaels:

'I am too qualified to be teaching mathematical literacy'

There is a shortage of qualified mathematics teachers, and to use me to teach it is such a waste. The syllabus is easy and anybody who can read is just about qualified to teach it²¹.

7.1 Introduction

This chapter presents the second teacher's (Michael Michaels) understanding and instructional practice with regards to the implementation of the new Mathematical Literacy curriculum. I begin the report by providing an explanation on how I came to know Michael and introduce him as both person and educator. This is followed by a description of the educational milieu in which he works followed by an account of the similarities and differences between his understanding of the curriculum document and the curriculum document itself.

Michael's perception of his instructional practice is then measured against his actual observed classroom practice, with the chapter concluding with the findings of why Michael teaches mathematical literacy in the way that he does. Emerging themes and findings from this case study, are framed within the three research questions and are further analyzed and compared with those from the previous case study and, ultimately, in the light of the conceptual framework in Chapter Eight.

7.2 Finding Michael Michaels

In April of 2006 I attended a Mathematical Literacy workshop with a colleague from my school in order to observe the training that teachers were undergoing due to the

²¹ Quotation from Michael Michaels during an interview (July 2006).

introduction of mathematical literacy. It is at this workshop that I met Michael Michaels. Of the sixty educators present at the workshop, Michael was not only the most vocal but also received the most positive feedback on his responses from the instructor throughout all the group presentations that he did.

On the third day during lunch Michael approached me and asked me if I was Greek. Having responded in the affirmative and establishing that his origins were Cypriot we continued with a lengthy and pleasant discussion on how we had grown up not even ten kilometers apart and had never before met each other. The Greek community on the East Rand was a very close community while we were both growing up and often held many social functions at which everybody got to know each other, for whatever reason our paths had only just crossed. Having heard that we had not yet offered the subject at the school where I was employed he invited me to contact him if we did so in the future, and had any questions pertaining to this new curriculum.

At the time it did not cross my mind to consider him as one of the case studies, as I initially thought I had already secured my respondents, the details of which I discussed in Chapter Four. After failing to do the research in the schools I had initially targeted, I contacted Michael and explained my study to him. Not only was he happy to hear from me but seemed extremely enthusiastic with been asked to participate in the research study; all he needed to do was to discuss it with the principal and he would contact me as soon as the permission was granted. Michael phoned me two days later and told me that his principal had agreed to allow me to observe his teaching practice.

I made an appointment to discuss the study with the principal and during this meeting it became clear why Michael was so enthusiastic. The principal told me that Michael was flattered that I had chosen him out of all the educators who attended the workshop to conduct the case study with. In a way, this was true, and I left the topic with no further discussion. I conducted the first interview with Michael that very afternoon and the classroom observations began three days later.

7.3 Curriculum Vitae - Abridged

MICHAEL MICHAELS

DATE OF BIRTH

15 May 1965 (41 years old)

EXPERIENCE

1990 – Present FET High School

Educator:

Mathematics Grade 10 & 11

Mathematical Literacy Grade 10

Physical science Grade 10

EDUCATION

1983–1985 University of the Witwatersrand

Bachelor of Science:

Mathematics III

Chemistry III

Physics I

1986 University of the Witwatersrand

Higher Diploma in Education

Teaching Subjects: Mathematics & Science

Elective: High School Sports Coaching

MILITARY SERVICE

1987 – 1989 South African Defense Force

INTERESTS

School Productions

Music

Michael is a forty one year old male educator at FET High School, one of three English medium high schools in a city situated twelve kilometers east of O.R.Tambo International Airport, in Gauteng, South Africa. Of Cypriot heritage, he is a first generation South

African Cypriot with Greek and English as the dual medium home language. He attended the University of Witwatersrand where he completed a BSc degree majoring in Mathematics and Chemistry. His academic degree was followed up with a professional teaching diploma with mathematics and physical science as his two teaching subjects.

His first choice was to study engineering but this, at the time, was not an affordable option to him and his family. He proudly describes the sacrifices both his parents made working late hours in a corner cafe to raise him and his three sisters giving them as many scholarly opportunities as the wealthier parents of his friends did. When the guidance teacher at the school suggested that he go to university on a bursary, as this could be easily obtained, for the then education department was partial to white males who wanted to enter the teaching profession, particularly in Mathematics and Science, he decided to change his career choice as it would be a lesser financial burden to his parents.

What is more was that his parents considered this a stable and esteemed profession. He explained that in Greece and Cyprus high school teachers are called '*professori*' and not educators like their primary school counterparts, which seemed to further sanction the career that he had chosen. Michael recalled the application process, which entailed a full physical examination including a urine test, and an interview with three men in dark suits and his then school principal. Since then he has attended several interviews but none that have made him feel that he had as much to contribute to the South African society. Serving in the South African defense force did however register as a close second.

At the time of this research Michael was in his seventeenth year of teaching having gained nearly two decades of experience in the same high school. Seventeen years however does not account for the entire relationship Michael had had at FET High School, as this was also the high school he attended as a secondary school student. He describes these twenty-two years as some of the best times of his life, and the loyalty he feels towards the school is evident in nearly all that he says.

On arriving at FET high school he was initially given the senior science to teach, as the head of the science department was on maternity leave. On her return, the mathematics department was shuffled around and from that time taught mathematics as of grade ten to twelve. Despite not having received the promotion position that opened up two years ago in the mathematics department, for which he applied, he decided to stay at FET High School at least until a position in a private school became available.

Initially he was interested in a promotion post only, but this changed when he was not given the head of department position at the school at which he taught for over fifteen years. He believed that promotion in government schools was no longer possible for white males, as the appointments were not done on merit but on what he called "blatant affirmative action".

I am more qualified than my Head of Department, and have many more years of experience. In the beginning I was bitter about what happened but when you ask around it is happening in all the schools. Everyone who can is getting out, either leaving teaching or applying to private schools. I do not want to leave teaching, I love the classroom, but enough is enough. How much more can one go on giving without been recognized? The government, year in year out complains about the shortage of maths teachers, perhaps if they looked after them there would be some qualified ones left in their schools.

Michael is also heavily involved in the schools productions and this dates back to his school days during which he annually participated in plays ranging from Shakespeare's Macbeth to musicals such as Grease. He has continued with this tradition of involvement, however this time being on the other side as choreographer of dance and even as director. This involvement he is passionate about, and readily admits that it would be one of the things he would miss most if he were to leave FET High School.

Uprooting his family and moving out of the city that he grew up in and has taught in for two decades also weighs heavily on the decision he has taken. However he does find strength in his wife's support for the decision to apply to private schools because being a

teacher herself she relates to what they believe are discriminatory appointment practices in government schools.

In 2006 Michael's teaching responsibilities at FET High School included two Grade 10 and one Grade 11 Mathematics class, two Grade 10 Mathematical Literacy classes and one Grade 10 Physical Science class. Extra-murally he was involved in the schools cultural productions and the training and managing of the schools solitary chess team, a duty that he explained was handed to him, when the chess coach of many years left, as he was the only educator at the school who admitted to having known how to play chess.

The school timetable, Monday to Friday, is made up fifty-four thirty minute periods of which he teaches forty-two. Of the remaining twelve periods he is required to attend the one assembly on a Monday morning, and the rest he can use to mark, plan his lessons or socialize in the staff room as he admits he often does. Five staff members constitute the mathematics department which he is part of, of which two are white and the remaining three black.

Apart from Michael, the mathematics department is all female and younger than him. With the exception of the comments made on why his head of department was appointed, Michael spoke fondly of his department and described them as a "very close team".

We work well together and support each other as much as possible. We share our lesson preparation and help each other set tests. We have to stick together as a mathematics department, you know how it is, on parents evening we have the longest queues. Everyone thinks their child can do maths, but what they seem to forget is why they could not. I even like my head of department, it is not her fault she was appointed, for that I blame the principal.

This glimpse of Norman's life history and teaching environment was informed by many casual conversations held over the five-week observation period and also by the questionnaire (Schedule A) whose one purpose was to gather such biographical information. Michael's background account is important as it is intractably linked to who

he is as an educator, and as such is central to his thinking and understanding. Similarly, so is the context in which he finds himself teaching in.

7.4 Michael's teaching environment

FET High School is based fifteen kilometers east of O.R.Tambo International Airport in Gauteng South Africa. Founded in the early 1900's it was re-positioned after two decades from what were temporary grounds, to the land it now occupies and has occupied for over one hundred years. It is a popular school and attracts long waiting lists in every grade; particularly in Grade Eight were many of the learners from the feeder primary schools annually apply. The school is highly regarded by the surrounding community for both its academic and sporting achievements.

It is situated near the center of the city in which it is found, with one of the city's main roads running parallel with the north side of the school building. FET city is a bustling industrial area with several affluent residential suburbs surrounding it. The learners that attend the school are mostly from new middle class South African families. The school has a strong support of children from past parents that also attended the school. Historically it has produced several prominent figures of the city, including a town mayor and a local sporting celebrity.

It is a beautiful two story building that is both well developed and maintained. It boasts a swimming pool, expansive sporting grounds and an auditorium. Freshly cut lawns lead up to the office block, which is central to the design of the school and houses the principal, the two deputy principals and the administrative staff.

The principal and one of the deputies are black males with the second deputy being a white female, which is also the gender and race of the four administrative staff responsible for the daily running of the school which includes setting up appointments, typing, registering learners and collection of school fees. Academic facilities take account

of two computer laboratories, two science laboratories a senior class and a junior class, one biology laboratory and a library on the second floor.

The computer laboratories each have twenty-five computers, which are all networked to the main server with continuous access to the Internet. The learners at FET High School have access to these laboratories during breaks and also after school, with a trained computer educator present at all times. The library is full of books, receives two copies of the daily newspaper and has several subscriptions to magazines such as *Pythagoras* and *Time*. It also has copies of the mid-year examinations and end of year examinations in each subject and for each grade. These are available to the learners at a nominal price charged for the photocopying which is mostly what the learners use the library for. The books and journals although available to the learners are hardly accessed and are used primarily by the academic staff as reference material.

One thousand one hundred and seven learners were registered at the school at the time of the research, with five classes in each Grade. Like most secondary schools in South Africa FET High School accepts learners from Grade Eight which, is the first year of secondary schooling, and provides for instructional development up to and including Grade Twelve, which is the exit point of high school in the country.

The racial composition of the school is an estimate, as the principal would not disclose this statistic. A bird's eye view during an assembly would place this at approximately forty percent white with the remaining sixty percent non-white. Once again this apparent statistic is only provided to establish the dynamics that have unfolded in Michael's life, in particular with the appointment of the 'black' female head of department.

Mr.Sithebe²², who has been the principal of FET High School for the past five years, readily admits that he makes staffing appointments that are conducive to transforming the racial composition of the staff room to be in profile with the learner body, but is assuring

²² Alias used.

when he explains that at no time do any of his appointments compromise the educational standing of the school.

The staff body is fifty-four members strong and has five staff members that have been teaching there for over a decade. Roots run deep in the school and the pride and loyalty of both the staff and students is apparent, not only in the neatness of their dress, but also in their discourse that has as its main emphasis the school's achievements and proud academic record. Relationships in the comfortably carpeted staff room are seemingly sincere and the camaraderie with the principal speaks of a unique leader who is not only well liked by his staff but also very respected.

Having undergone an Umalusi²³ compliant Whole School Evaluation in the year previous to the research, the school principal is in possession of several statistics that make him and his staff proud. These include a comparatively competent staff body, a happy learner and parent community, and an operationally successfully functioning school. However the statistic that is most spoken about is the one that relates to bullying. The principal is quick to explain how the surveys conducted with the learner body during the whole school evaluation showed FET High School to have a statistic on learner bullying which was significantly lower than the average provided by the Umalusi records.

Contributing to this, the principal explains, is the no tolerance of any form of discrimination that is not only entrenched in the school policy, but in the beliefs of his staff. The students are continuously encouraged to have a high regard for this policy and are exposed to several discussions on respect and tolerance, not only in assembly periods but also during the morning registration period.

It took one expulsion after an arduous disciplinary hearing with a Grade Twelve learner who was found to be threatening and intimidating a new Grade Eight learner three years ago, to set the example of the sanction for any such behavior. It seems to have worked, and since then no hearings in this line of grievance have been held again.

²³ Council for Quality Assurance in General and Further Education and Training-in South Africa.

Classrooms at FET High School are relatively big, with approximately thirty-five desks and chairs in each with very little graffiti and as much litter on the floor. Freshly painted walls and windowpanes are further indicative of the Whole School Evaluation as are the posters on the wall pertinent to the learning area taught in the individual classrooms. Recent learner projects occupy most of the spaces on the boards in the classrooms, more evidence of, as Michael called it, “the big inspection”.

Michael acknowledges that his reaction was no different to that of the schools and joined them in window dressing his classroom with posters depicting mathematical formulae, various famous mathematicians, Einstein, and neatly typed up and enlarged copies of the learning outcomes for both the five learning outcomes in Grade Eight and Nine Mathematics and the four of Grade Ten FET Mathematics. Surprisingly, the Mathematical Literacy outcomes do not appear anywhere on his walls.

The classrooms also have radiators for heating built into the walls that were found to be continuously switched on through the bitter winter that accompanied this case study. Warmth however, also radiates from the students who are respectful and polite greeting visitors, staff and strangers in the corridors throughout the day.

High wire fencing surrounds the school and an electric gate is the main access to the school for visitors, learners, staff and parents. An intercom announcing ones arrival is situated near the gate, which has the metal crest of the school proudly emblazoned on either side of it. In the car park, is a flagpole, and the Student Representative council members, who rotate the duty amongst them, religiously bring it down at the end of each school day, and hoist the South African flag up every morning. Car park shading is provided for the senior management staff that also has reserved parking bays with the positions that they hold written on small but visible placards.

The foyer area outside of the school hall proclaims the schools history with photographs of highly achieving academic scholars and sporting teams whose results and records are written below. What does strike a visitor however is that these photos only run up to 1999

with the last seven years of the schools achievements not been reflected. Wooden boards with the names of the Head Boy and Head Girl²⁴ are mounted on the walls on the front of the school hall but once again only have names unto and including 1999, the year after which the prefect body was discontinued and the Student Representative Council introduced.

Academic time begins on a daily basis at quarter to eight and ends at three in the afternoon. Most weekday afternoons are filled with sporting activities which include many practices and as many matches. Student involvement in the extra-mural offerings is compulsory and the field is filled with enthusiastic sweaty learners not only on the weekday afternoons but also on many a Saturday morning.

The mathematics department, as previously mentioned, is five staff members strong and is regarded as one of the best by the surrounding schools, evidenced in casual discussions that I had at one of the cluster meetings Michael invited me to attend with him during the course of the research study. His head of department is a dynamic lady who is a staunch disciplinarian not only in the classroom but also in the way that she conducts the weekly mathematics department meeting. It is a 'youngish' department with Michael being the only member who is over forty years of age. Departmental dynamics on observation surface as honest and open, with several meetings resulting with a walk to the well stocked tuck shop for refueling after methodical planning.

7.5 A Snap Shot of Michael's Grade 10C Mathematical Literacy Class

Grade 10 C had thirty-two learners doing mathematical literacy, and Michael Michaels had been assigned to teach this class, which is one of the two grade ten mathematical literacy classes that he taught in 2006. Of the thirty-two learners twenty-seven failed the end of year examination in Grade Nine. Their parents were contacted by Michael's head

²⁴ Traditionally in South African schools, these members were the heads of the prefect body which was normally elected without transparent procedures.

of department at the end of that year and invited to a meeting to discuss their subject choices for Grade Ten.

At the meeting, the principal, the head of department and Michael spoke to the parents with regards to the difference in the level of difficulty between mathematics and mathematical literacy and also provided the parents with information on what mathematical literacy entailed. Collectively they recommended to the parents and learners that they should do mathematical literacy, as it was not only easier but of more relevance than the 'abstract' syllabus of Grade 10 Mathematics. Michael explained that the only concern of the parents at the time was whether taking the subject would prevent their children from studying at a university once they had completed high school. Having been assured that their children could study further at a university both the parents and the learners were satisfied with taking mathematical literacy as a subject and not mathematics. Part of Michael's explanation of this process included the following:

We sold it to them. It was not difficult to do, most of these pupils have never coped with mathematics and this was an option out of doing mathematics without closing the door to university. Most parents were relieved to hear that they could go to Grade Ten and did not want to repeat the year (Grade Nine). The work is really easy but some of these pupils are still not copying, they are passing, but only just.

Three of the remaining five learners elected to do mathematical literacy of their own accord and their Grade Nine results showed that although they had passed the end of the year examination they had only managed to do this by several percent. The last two, were new students to FET High School and were placed in the mathematical literacy class because of a history of difficulty in mathematics in their previous schools.

Of the thirty two learners thirty one had attended an ex-Model C²⁵ primary school with English as the language of instruction which was however only the home language of twelve of the learners with the rest having several African languages. What was noticeable in this class was that twenty-eight of the learners were 'Black African'. This

²⁵ During apartheid years these were white only schools.

majority representation was also the case in Michael's second class of mathematical literacy. Statistically, at FET High School eighty nine percent of the grade ten learners doing mathematical literacy were 'Black African', which on the surface seemed at odds with the schools approximated racial constitution.

All the students had a mathematical literacy textbook, which was the same as the one Michael used to teach with, and had access to the new Casio fx ES scientific calculator, both of which belonged to the school. The students were allowed to take the textbooks home on a daily basis but not the calculators. Michael, when required by the nature of the lesson issued these to the learners, which they diligently returned at the end of each lesson. On rare occasion they were permitted to take them home on weekends if there was homework that required them and the more senior mathematics class of Michael's, namely Grade 11 B-Mathematics, was not using them. Michael explained that this was not a trust issue but that he had only forty such calculators, which he required for the teaching of all the classes that were allocated to him, and his priority had to be the more senior learners, which in turn, in the following year, would be the current Grade 10 C's.

Seven of the learners in Grade 10C did have a calculator that belonged to them and all of the learners possessed a hard covered note book which they used to take down notes and paste worksheets that were handed out. The notebooks were neatly kept and the learners used these exclusively for mathematical literacy.

This class was taught mathematical literacy in Michael's classroom, which was positioned at the end of a corridor on the second floor of the school. The classroom itself was well ventilated, neat, had desks that were arranged in groups and positioned in such a way that the learners could see the blackboard at the front of the classroom even though some learners needed to crane their necks to do this. Although the desks and chairs occupied most of the floor space, because of their positioning Michael could move amongst the learners with relative ease.

Having established Michael's working milieu, I precede with a discussion of the research findings that pertain to the studies research questions. I begin with framing the evidence in research question one.

7.6 Michael's understandings and perception of the purpose, problems and possibilities contained in the mathematical literacy curriculum.

Evidence for research question one, what do teachers understand to be the purposes, problems and possibilities contained in the mathematical literacy curriculum, was obtained from various data points as outlined in the research design and methodology chapter, namely Chapter Four. These points included semi-structured interviews that preceded the classroom observations (Schedule C), casual conversations and the semi structured interviews that were held after classroom observation (Schedule D), the questionnaire containing both open and closed ended questions (Schedule A), an in-depth document analysis of curriculum and related guidelines (Schedule G), and notes from the researchers journal (Schedule J). An explanatory theoretical analysis of the findings will follow this description and exploration in Chapter Eight.

7.6.1 Identity dilemma

Michael knew he would be teaching mathematical literacy at the end of November 2005, which was when he was asked to attend a meeting by his head of department during which together with the principal were to inform the parents that their children should do mathematical literacy in Grade Ten. He was not asked if he would be willing to teach this curriculum nor was it explained to him why he was asked to be the only member in his department to do so. Why he never asked for an explanation or the motivation that his head of department had used to assign the responsibility of this new curriculum to Michael was unclear.

What was clear however is that Michael did not believe that he should be the one in his mathematics department that should have been asked to teach it:

Younger teachers should teach the Mathematical Literacy or teachers who are not as qualified as I am. Teachers who have experience teaching standard grade would be the best suited, they know how to handle the weaker pupil. Initially it was reported that Geography teachers would teach it, I think that this is necessary. It is important to use the one's that cannot teach Higher Grade Mathematics. There is a shortage of good Higher Grade teachers, everyone knows that. To use me is a waste. The syllabus is easy and anybody who can read and add is just about qualified to teach it. She (head of department) gave me both classes to teach, she did not even consider given it to the other staff.

Continuing he added:

It is politics all of this .There is not much I can say because then it will seem that I am racist because I think I am a better teacher than the rest of my department. Teaching Mathematics is what I love; this is not real maths. Do they think that I cannot teach mathematics? My results have always been excellent. I am not a mathematical literacy teacher!

This is why I am looking to apply to a private school, and then I do not have to mind my p's and q's. I can just get on with teaching what I love, and be respected for what I teach. I have always loved mathematics, I got a distinction²⁶ in Matric, and now I am told to teach mathematical literacy... (he shakes his head).

Michael's attitude towards having been told to teach mathematical literacy was not only negative but also emotional. His sense of disbelief that he was the one teaching mathematical literacy was tangible, as tangible as his insistence that he loved teaching Mathematics. What was however intangible was why he held this reality. Why did he understand that educators teaching mathematics as opposed to mathematical literacy were somehow the stronger teachers? Why did he believe with such strong conviction that he should not be teaching mathematical literacy or be known as the mathematical literacy teacher? Were these views intrinsic to his understanding of the value and status of mathematical literacy, or a result of the public opinion, which he understood, held mathematical literacy with low regard? How did this negativity and apparent threat to his

²⁶ A distinction is 80% and above in a subject and is a milestone in the end of year, external, Grade 12 examinations in South Africa.

teaching identity that he was feeling, impact on the implementation of mathematical literacy in his classroom?

Honesty and openness were character traits that Michael exhibited throughout the study as was the struggle he was experiencing on what it really meant that he was now no longer only a mathematics educator but also a mathematical literacy one as well. Despite his expressed feelings he did however articulate enthusiasm and motivation to teach the subject:

I am not saying that I will not do my best. I enjoy teaching mathematical literacy because pupils who never before passed mathematics now have an opportunity to pass and when they realize that they can pass they will start enjoying coming to my class. It's just that it is not a challenge. You do not put up a sum and think I hope they don't ask me for an answer now, because sometimes you cannot just see it. Then you go home and do it, and think uhh, this is tricky but only because it is different. It is exciting the next day, to see which pupil managed it. It's just; I do not want to be known as a mathematical literacy teacher only. This is something extra I do, not who I am.

Michael identified himself as a mathematics teacher and wanted to continue to do so. His love for the subject and ability in it, had contributed towards this construction, which he was proud of. With the teaching of mathematical literacy, he was however confronted with what he perceived as a threat to this identity. He did not want to be known as the mathematical literacy teacher. In further interviews it was evidenced that he believed that to be known as a mathematical literacy teacher implied that he was not only a 'lesser' teacher than those teaching mathematics, but also less intelligent:

At least I still teach normal mathematics this year. But what will happen in the future if I stay here? Teach all the mathematical literacy? They (parents and students) will think it is because I am stupid, you know, not capable of teaching mathematics.

For Michael it was evident that he believed that mathematics teachers were considered intelligent, or at least more intelligent than those teaching mathematical literacy. As such,

the teaching of this new curriculum and the possibility that it may impact on how he was perceived by the parents and students, threatened the professional status of his identity as an educator. Was this further linked to how he understood the nature and purpose of the new curriculum?

7.6.2 Broad understanding of implementation

Michael indicated on the questionnaire that he understood the Mathematical Literacy curriculum to a large extent and that it provided guidelines for implementation that were however not flexible. The associated Learning Programme Guidelines and Assessment Guidelines he also declared that he understood to a large extent and further showed that he had copies of all three documents. Implementation guidelines, as for the curriculum document he found to be descriptive and allowed for no flexibility. He explained this as follows:

Implementation of this curriculum is easy, the content is simple stuff and relevant to teach, however it is rather prescriptive in that the curriculum is long and to finish it in one year is not to do justice to the weak pupils who are taking the subject. If it (curriculum) was shorter I could spend more time on the sections that the pupils find difficult, which given their maths ability with which they come into Grade Ten is nearly all the sections. I was doing compound interest with them a while ago, and instead of doing questions that they would find interesting I had to spend time showing them how to use a calculator. As soon as I changed the unknown in the formulae they were stuck and we had to go back to solving equations with various unknowns.

This happens all the time, these pupils do not have the basic skills, these need to be taught before they can apply them. We spend so much time on the actual mathematics that introducing interesting contexts, that they have told us to do, would slow us down so much that we would not complete the syllabus at all. It is obviously better to teach less and teach it well, than to finish the syllabus and have no children understand the work. But we cannot do this because what happens if you leave out a section and they need this in the matric exam? If the pupils come out and complain that it was never taught the teacher is in trouble, if the work was taught and the pupil did not understand it that is a different story.

Michael is clearly conflicted in the way that he is implementing the curriculum (too fast) with the way that he would like to. Speed seems to be winning, as he believes that, that is what the curriculum document requires of him. This perception does seem to be aligned with the curriculum document that not only spells out the learning outcomes that need to be 'taught' but also the content that each outcome requires. Taking the Data Handling outcome as an example, Michael emphasized his point by showing me the following part of the curriculum policy:

The learner will investigate and interpret situations, which can be dealt with using statistical techniques. The following and other content and concepts will assist the learner to do so.

Grade 10

- Construction of questionnaires.
- Populations.
- Selection of a sample.
- Tables recording data.
- Tally and frequency tables.
- Single and compound bar graphs.
- Pie charts.
- Histograms.
- Line and broken-line graphs.
- Mean, median, mode.
- Range.
- Relative frequency.
- Probability. (DoE, 2003:41).

At a glance of the curriculum, Michael's concern seems justified. However a deeper inquiry into the curriculum document reveals that the progression of content over the next two years is diminished with an increase in complexity of situational contexts. The curriculum document further specifies that the, ' content must serve the Learning Outcomes and not be an end itself' (DoE, 2003:38). Differentiation of content from context, which is misaligned, with the curriculum document, seems to be Michael's difficulty with time management.

A deeper understanding of the curriculum as a whole and also a deeper understanding of teaching 'mathematics in context' would perhaps allow Michael to hold a different view

about the actual length of the curriculum. The question that this raises is how and when this will take place as Michael had already attended a Mathematical Literacy Workshop that he found to be of little relevance:

The workshop was a waste of time. They spend the entire time showing us how to teach and prepare a lesson. Perhaps for those teachers who cannot do mathematics this would be worthwhile. Perhaps they should have two different workshops, for those who can do mathematics and are qualified and those that have never taught mathematics before. Maybe it will help them. I know what a budget is. They spend so much time on the financial aspect of mathematical literacy. Anyone with a degree knows all that stuff. It then becomes a matter of adding a context and showing the pupils the application of what has been taught as it applies to real life examples.

Having analyzed the workshop notes that Michael still had in his possession, I was acutely aware that the emphasis had been on the process of teaching 'mathematics in context' which reflected the curriculum intentions both in terms of purpose and possibilities, however no emphasis was placed on explicitly stating that the teaching of the content could not proceed the introduction of context, this was only clearly stipulated in the curriculum document. Was this why Michael was not attuned to this? Why did he process all this to imply that the only change required was adding on context after content had been taught? Granting the time obstacle, would this surface level understanding of the curriculum intention further impact the implementation pathway of Mathematical Literacy in his classroom? Would Michael even be aware if it did?

What seemed to also meaningfully impact on how Michael proceeded with the implementation of this new curriculum was an examination that was to take place two and a half years down the line, from the time of the study. The role that the externally set matric examination plays in the implementation pathway of this curriculum is pivotal as learner attainment is explicitly, as Michael stated, sacrificed for personal objectives, which mainly include avoiding school sanctions.

The reality of the pressure of the grade twelve externally set examinations is not unique to mathematical literacy as it has been part of the South African secondary school assessment landscape as far back as can be remembered. However acknowledging the reality of the damaging role these examinations play as opposed to 'best practice' play a part on how Mathematical Literacy is unfolding in Michael's classroom. What is pertinent is why Michael does not take in hand the circumstances he is faced with in a changed way? Why does Michael not question if there is a way to finish the curriculum and avoid the sanctions that he so fears while at the same time addressing his learner's needs?

Conceivably this would require a deep change, necessitating the abandonment of past practice and beliefs. A change that if it is to transpire will call for both external and internal forces that question and challenge both Michael's perceptions of the role of these externally set examinations and hence his instructional practice. What remains unanswered is, even if these forces exist, how and why will they reach Michael?

It is important to point out that that these findings only reflect Michael's awareness and understandings at this particular point in time. As this was only the first year of implementing mathematical literacy and less than eight months down the line since the introduction of this curriculum in the actual classroom, these beliefs and understandings could change over time. However what is germane is that if the change is not sought by the teacher the understanding may remain at the same level indiscriminant of elapsed time.

7.6.3 Concept Definition

Michael defined Mathematical Literacy as a concept as follows:

It is the equivalent to literacy in reading. Mathematics is a language and as such needs to be interpreted with a vocabulary of its own. You need to understand where you can use the maths you are taught in real life to understand mathematics. Mathematical Literacy is about teaching the pupils of how mathematics can be used in their daily lives. I think it is the beginning of mathematics.

This response is indicative of a widely embracing concept classification that traverses over various definitions found in the extensive literature. What is purposely worthy of observation is his assessment that it is the 'beginning of mathematics' as it seemingly implies that one can only advance to mathematics when one is mathematically literate. This supposition that mathematical literacy is a preamble to mathematics then further positions the subject as 'lesser' than mathematics. A standard, which if held to be true can impinge on the unraveling of the mathematical literacy curriculum in the course of implementation in Michael's classroom.

7.6.4 Curriculum Purpose

Having asked Michael on what he thought the reasons behind introducing mathematical literacy were, he responded:

Because the government has done away with standard grade in all the subjects. In maths this is not possible, because they (students) cannot all do maths. So they have provided an alternative for these children that struggle with normal mathematics. It is the government's way of making sure that every child has some maths even though it is not real maths. If taught properly it can be useful because at least these children can make sense of simple maths that they encounter in their lives. If taught properly, everyone can do maths literacy; it is in reach of every child. The problem is schools commit treason when they take teachers who do not know maths to teach maths literacy.

Michael's weakness to provide a response that takes in official curriculum purposes with respect to transforming the 'poor quality or lack of education' of the past which unopposed contributed to 'very low levels of numeracy' in the adult population of South Africa exposes Michael's thin understanding of the new curriculum's purpose (DoE, 2003). The reference to mathematical literacy being 'not real maths' once again unveils his position with regards to the 'lesser' status that this curriculum holds.

Evidence in support of this also came from the questionnaire where he marked that he strongly agreed that mathematical literacy is a 'watered down version of the more abstract

Mathematics curriculum'. What is more, his reference to 'treason' is confusing for in a previous discussion he expressed a viewpoint that held that anybody with the ability to read could teach mathematical literacy. This contradictory data was perpetuated whenever Michael answered a question that was in his view a reflection of his ability to teach mathematics. When generalizing Michael's responses were found to be more positive about the nature and worthiness of the mathematical literacy curriculum, however when he framed the question more personally his responses were negative in terms of the value or worth of the curriculum.

In the questionnaire, Michael showed a somewhat deeper appreciation of the curriculums intended purpose. He indicated that he agreed that the curriculum be viewed in relation to the larger agenda of transformation and that it was a mandatory alternative to mathematics because of the 'low levels of numeracy' in the country. His inability to align his written response to his articulated reply is indicative of a lack of ownership of the curriculum. How these disparate mind-sets, between the personal and the general, the intended and the interpreted, invade Michael's instructional practice will be authenticated in the *Observed Instructional Practice* section of this chapter.

7.6.5 Curriculum Possibilities

Working on the postulation that the offering of the new mathematical literacy curriculum is an opening to expose learners not only to new and different knowledge but also to the acquirement of skills that are required for survival in the information age, I proceeded to ascertain what Michael believed these to be. Two lines of inquiry were used to explore this. One was a macro level inquiry on what mathematical literacy could offer on the whole and the second on a micro level, as to what opportunities each learning outcome could provide for.

7.6.5.1 Macro Level

The curriculum document interweaves the opportunities that it allows for with the actual purpose of the curriculum. This close link allows for the argument to be made that if a deep awareness of the curriculum possibilities is not held, a surface level of understanding purpose will also persist. Taken together, this level of understanding will play a significant role on how the curriculum unfolds in a classroom.

There are three distinctive contributions that the curriculum can provide for as outlined in the document. Firstly it provides for skills and knowledge that allow a learner to tackle everyday life mathematical demands and as such go towards developing 'self-managing' persons. Secondly it provides for developing numeracy that will enable a person 'to be a contributing worker' in the mathematically demanding workplace of current times, and thirdly empowers 'participating citizenship in a developing democracy' (DoE, 2003:10).

This third global opportunity is fundamental, for not only is it explicitly stated in the curriculum but is also part of the greater transformation of the fledgling democracy in South Africa as it goes as far as shaping policy:

To be a participating citizen in a developing democracy, it is essential that the adolescent and adult have acquired a critical stance with regard to mathematical arguments presented in the media and other platforms. The concerned citizen needs to be aware that statistics can often be used to support opposing arguments, for example, for or against the use of an ecologically sensitive stretch of land for mining purposes. In the information age, the power of numbers and mathematical ways of thinking often shape policy. Unless citizens appreciate this, they will not be in a position to use their vote appropriately (DoE, 2003:10).

Michael indicated that he strongly agreed that the curriculum enabled learners to become numerically self-managing persons, contributing workers to society, and participating citizens in a developing democracy. He also agreed that it can achieve this, as it is suited 'to dealing with issues related to human rights, environmental and social justice', as it extends 'opportunities in engaging mathematics in diverse contexts', and also in that it

'values indigenous knowledge systems'. This initial indication of Michael's was in complete alignment with the intentions of the curriculum. However a doubt was cast on this level of understanding when he was asked to provide an articulated response, as can be seen in his following statement:

Well, it is better than nothing. In most schools, not good schools like ours, a lot of pupils do not take mathematics not even on the standard grade. This is one way of making sure that every pupil does do basic mathematics. It is like reading and writing, everyone needs to be able to read and write-in the same way everyone must be able to do some mathematics. It has no other real positives, you know it closes most university doors; the good faculties do not accept pupils doing mathematical literacy. Like I said it is better than no maths at all. But that is about it. So that all pupils can do mathematics, even though it is an easier mathematics. The pupils doing mathematical literacy will at least leave school knowing how to do maths that they will encounter in their daily lives.

One point in Michael's response exhibits that he believes that mathematical literacy can provide opportunities to the students that will allow them to deal with numerical situations that they are presented with in everyday life, which is indicative of some alliance with the curriculum document. However his articulated response by no means reflects the depth of understanding of the curriculum possibilities, as does his written one.

Given the claim that Michael has read and understood the curriculum to a large extent, the discrepancy between an ability to recognize the possibilities and an inability to express them when the visual is not present raises various contemplations. How is ownership of a curriculum arrived at? Why has Michael not yet acquired this? Will time play a role in reforming his perceptions and understanding? Is time pertinent in undergoing deep change when questions and reflection are absent at the onset of implementation?

These deliberations are significant as Michael exhibited a distinct detachment from the level of understanding he expressed in writing. He had an air of confidence and was

always seemingly pleased with his responses, even though he guarded them with self-justification. The following vignette of one of his utterances exemplifies this:

I am lucky I can do this maths. I do not know how other teachers are copying though, there is a lot of new maths in the syllabus and they need to learn this before they teach it. At the workshop, some teachers did not even know the compound interest formulae. But nobody wants to talk about what is really going on because then it becomes a matter of race

He added:

I was at WITS and participated in many of the anti-apartheid demonstrations. We were tear gassed often and had to be very careful because we were warned if we were ever arrested by the police we would loose our bursaries, and yet we took our chances. Nobody is saying what we had was perfect but everybody is scared to comment on the new stuff because then it may seem you are racist and support apartheid education. Rather than settling down and teaching we are always introducing something new and attending courses, and we never really get into anything before it changes again. You know even this curriculum and all the other FET curricula are again going to be revised in a few years. Then maybe we will start over again. At the end of the day it is the pupils that are suffering. I feel sorry for the teachers who have to learn all this new stuff. I am fine, I can do mathematics How is the government helping them?

His general perception that he somehow understood mathematical literacy better than other mathematics educators was seemingly based in his own self-confidence, as there was no proof of an external rationalization for this. This self confidence in his ability and understanding begs the question as to how will Norman acquire a deeper understanding of the curriculum when he does not in any way question his understanding thereof? Furthermore, how will his surface level ownership of the curriculum possibilities affect the implementation pathway of mathematical literacy in his classroom?

7.6.5.2 Micro Level

As previously discussed, in Chapter Six, the line of inquiry on the possibilities of the curriculum in terms of learning outcomes was pursued in order to extract the finer level

of what opportunities and possibilities the curriculum could provide for. The design in pursuing the evidence for this question was kept very similar to that in the previous case study and once again scaffolding was used in the questions to compensate for the 'newness' of the curriculum's use of learning outcomes.

Interviewer: Learning Outcome 1 Number and Operations in Context. The learner is able to use knowledge of numbers and their relationships to investigate a range of different contexts, which include financial aspects of personal, business and national issues' (DoE, 2003:11). How do you understand this outcome with regards to learner opportunities?

Michael: Money, money, money. This outcome helps pupils with all issues related to personal finance. It is one of the best sections, and when I was at school and did Additional Math²⁷, this was my favourite section, and I really enjoyed it. It helps with understanding why people should try and not owe money to banks and how these financial institutions at the end of the day make millions from ignorant people. If you speak to teachers you will see many of them call mathematical literacy, financial maths, even some of the pupils do.

Although the importance of the use of financial contexts in learning outcome one cannot be denied it is not exclusive to such contexts only. Michael's limited interpretation of one context only is representative of having attached a context to achieving an outcome which he is familiar with. The choice of context is not what is of as much connotation as is how he relates to it. His example of banking and interest seems to be a situation with which he associates and many of the learners may find themselves also having to deal with, if not presently, at some point in their working lives. What is lacking however is any mention of the use of a context that is sensitive to financial practices that are not of a 'Western Culture' that may be pertinent to the daily lives of a large majority of his learners and their families. The curriculum document states (DoE, 2003:43).

Another aspect of providing access and affirmation for learners of Mathematics is to look at examples in the variety of cultures and societal practices that exist in our country...The flexibility allowed by the

²⁷ Additional Mathematics was an advanced program Mathematics offered to high achieving learners in Mathematics by secondary schools. In the FET, Additional Mathematics was not approved as a subject.

curriculum also promotes the incorporation of local practices as starting points for or applications of the Mathematics to be investigated.

As contexts are central to the development of Mathematical Literacy in learners' it is important to consider the effect that the choice of these will have on the implementation of mathematical literacy. Will Michael's surface level understanding of the curriculum allow for contexts other than those that he relates to? Will he allow his learners to select contexts that they deem important and of interest? Will he respectfully convey them as valuable and essential to his learner's lives even though they may not be to his? What will oblige Michael to even consider alternative contexts?

Did Michael's response to the first learning outcome reflect an understanding that was common to the rest of the outcomes?

Interviewer: 'Learning Outcome 2 Functional Relationships. The learner is able to recognize, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts.' (DoE, 2003:12). What possibilities in terms of real life applications does this outcome afford the learners?

Michael: This section is helpful because it teaches the pupils how to draw graphs. This is important, because they can use this skill to represent information in a way that is understandable to other people who do not. It also teaches them how to interpret graphs that can be found in newspapers and magazines. We have always taught this maths, you know the graphs we always do, straight line, parabola, circle etc. This new syllabus does not require that we teach all these graphs, only the straight line and interpreting other irregular graphs. I still teach them because I feel they are important, spend a bit of time on doing all the equations, circle, hyperbola, straight line and parabola and then show them how to sketch these. With the new calculator all they need to do is put in the equation and it provides them with the table of ordered pairs. Then all you do is plot them.

Michael's explanation revolves around various functions that can be taught and interpreted when teaching towards acquirement of this outcome. He also finds it important to teach graphs work that he says is no longer in the syllabus. Learning Outcome Two is however not functions but Functional Relationships and includes a

considerable array of various relationships that can be dealt with in various contexts of relevance to learner daily lives.

His interpretation of what is required in this outcome with regards to providing the learner with the learning opportunities that it can seem rather limited and entrenched in his past instructional practice. It is likely that it is not a lack of subject knowledge that is stirring his ability to comprehend the possibilities and intentions of the outcome as intended, but rather his lack of a deep understanding on what the nature of teaching for mathematical literacy advocates. Separating the content from the context in his explanation of his instructional practice is further substantiation of this frivolous understanding which will be pursued further in this chapter in the section dealing with his observed and claimed instructional practice.

In the questionnaire Michael indicated that he was not sure if the Mathematical Literacy curriculum was credible in quality and agreed that it provided for minimum conceptual knowledge. These indications were further manifested during the interviews where he often proclaimed that mathematical literacy provided for some skills and knowledge but only of worth as opposed to no mathematics at all. Beliefs and perceptions are basis for decisions and actions, and as such the value that Michael believes mathematical literacy holds will contribute towards the opportunities his learners are afforded in his instructional practice.

These values that Michael holds on the worth of mathematical literacy are not only negatively impacting on his status as a mathematical literacy teacher but also misaligned with those that the curriculum proclaims (DoE, 2003:11):

The Learning Outcomes of Mathematical Literacy are designed to enable learners passing through the Further Education and Training band to handle with confidence the mathematics that affects their lives and so be appropriately educated for the modern world. They will be able to proceed with learnerships in career pathways that require Mathematical Literacy at the relevant National Qualifications Framework (NQF).

Students proceeding to Higher Education institutions will have acquired a mathematical literacy that will enable them to deal effectively with mathematically related requirements in disciplines such as the social and life sciences.

This depth of opportunity and promise, as stipulated in the curriculum, does not form part of Michael's understanding of the purposes and possibilities contained in the curriculum. He seemingly compares the curriculum to the Mathematics curricula of the past and the core mathematics curriculum of the present, which he believes afforded and afford more skills and knowledge and as such judges this new curriculum to have lesser worth. Does his belief that he is sure he is teaching a subject of 'lesser' quality than Mathematics, matter to how he teaches it? Will his attitudes and perceptions shape the way his students act in response?

This thin and disconnected level of understanding the possibilities contained in the learning outcomes also surfaced in Michael's response on learning outcome three.

Interviewer: ' Learning Outcome 3 Space, Shape and Measurement. The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.' (DoE, 2003:12). How is this outcome of any significance to the learners' every day lives?

Norman: We have only covered a small section of this outcome; we did the conversions, meters to centimeters, cubic meters to cubic millimeters things like that. We have also done area and volume, which was also part of the old syllabus. All this work is very important because it is useful in everyday life. The pupils can use this to work out measurements and volumes. We also have to do scale drawings, which I have been looking at because I will be teaching that section soon. This will really be worthwhile as interpreting and designing plans can help the pupils with house plans and budgets. Once they have a scale drawing they can use it to find out say the cost of building or painting a wall.

Michael's ability to find and express real value in the pursuit and attainment of this outcome is in stark contrast to his overall perception of the value of the curriculum. This

binary viewpoint is confusing not only in that it seems unpredictable as to which one will manifest in his instructional practice but also that he does not seem to be aware of his opposing held values. How is it that he holds the curriculum to be of little worth but can to some or other degree find value in all the learning outcomes? Why does this value that he does identify in each outcome vary in degree and also not form part of his overall evaluation of the curriculum? What are the implications of this on the pathway that Mathematical Literacy follows in his classroom?

The level of understanding that Michael had shown in his above responses was broken with that given for the fourth and last outcome.

Interviewer: 'Learning Outcome 4 Data Handling. The learner is able to collect, summarize, display and analyze data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.' (DoE, 2003:12). What possibilities in terms of real life applications does this outcome afford the learners?

Norman: Many possibilities. Data Handling is important because statistics and probability play a big role in our daily lives. The pupils benefit a lot because they are spending time on work that they not only understand and enjoy but work that is of benefit to their everyday lives. This section is a lot about representation and the pupils do not have to do many calculations. Once it is taught properly they understand it because it is not really based on mathematics from last year that they found difficult. Statistics is everywhere and an awareness of how this can be manipulated to put across a particular viewpoint, especially by politicians is very important in making sense of the reality around us.

If one was to examine Michael's above response in isolation, as to how Data Handling can make available learning possibilities for learners pertinent to their everyday lives, one would be likely to conclude that Michael highly regarded the quality and opportunities that this new curriculum provided for. Added to this, if one was able to witness the fervor and excitement he expressed when answering this question one would be convinced that this conclusion was valid. However this response cannot be viewed in isolation of his overall perceptions, which contradict these individual retorts on the outcomes.

It is uncertain as to whether Michael felt obliged to answer these questions in the affirmative because of how that were posed or if he actually did value the quality of the curriculum but somehow felt that he should not express it. What seemed to be probable was that Michael was enjoying teaching the curriculum and found several of the sections valuable and enjoyable, but to admit this overtly may result in concluding that he was a mathematical literacy educator, a label that he clearly indicated that he did not want to wear. Why Michael had endorsed this label to be of little brand seemed to be more about an outside perception and less about how it actually suited him.

Further problems that Michael articulated are discussed below.

7.6.6 Problems

Implementation difficulties of new curricula are recorded in the literature extensively. In developing countries it is often the case that a shortage of resources, both material and in terms of human capacity, affect the implementation pathway of curricula as intended. However difficulties in implementation are not only as a consequence of resources and as such in this section I inquire deeper into the problems that Michael claimed to have in implementing the new mathematical literacy curriculum. Such insights may contribute towards gathering evidence on implementation difficulties in developing countries when educators are asked to introduce a new mandatory subject which in turn may inform the design not only of future revised versions of the curriculum but also of staff development programs.

In the questionnaire Michael indicated that the curriculum document did not provide guidelines for implementation. He also indicated that he was not sure if the two related documents, namely the Assessment Guidelines, and the Learning Programme Guidelines provided guidelines for implementation. Furthermore Michael reported that the implementation of the curriculum was not flexible.

7.6.6.1 Curriculum Flexibility

Having designated that he found the implementation of the curriculum not to be flexible I asked Michael what he meant by this. His response is given below:

The curriculum is very prescriptive of what needs to be taught. It is a lot of work and you cannot leave any of it out, as you need the grade ten work for grade eleven and the grade eleven work for grade twelve. At the end of grade twelve when they write the end of year matric exam I have to make sure that they have covered all the work. So it becomes difficult because I know that some of the pupils in my class are lost but if I slow down for them and re-teach a section or do revision I will fall behind in grade ten, then I will never catch up again. Can you imagine if any pupil fails mathematical literacy in matric? I know what they are saying, that no pupil will fail for at least two years, but we do not have this in writing so I do not want to take the chance.

He continued:

But I have found a way around it. As far as possible I make sure that I teach all the mathematics first, in this way giving the pupils the maths they need to solve problems. Then depending on how much time we have according to my planning schedule I do examples, as many as I have time for. These examples show the pupils where the maths that they have done can be applied to the real world. I think that this is the best approach, because at the end of the day it does not matter how many examples you do with them anyway because the questions in the final matric exams will be different anyway. It is more important that they can first do the actual mathematics, the application will then come. It is like building a house, if you do not have the foundation no matter what picture you have in your head you will not be able to build the house.

Michael's response raises two important matters. Firstly as mentioned earlier, the impact that the externally set end of year grade twelve examination has on his instructional practice, and secondly the choice of compromise that he has made, namely the teaching of content and then if, and only if, time permits the content in context.

7.6.6.2 Grade Twelve Examinations-End of Year

The pressure that Michael is feeling for an examination his learners are going to be writing in two and a half years time is explicitly impacting on the choices he is making as to how to implement the curriculum. This single assessment's influence is not only negatively contributing to the curriculum's intentions but also to the anxiety levels of Michael's being. In casual conversations with Michael he revealed that the school places so much emphasis on its matriculation results that educators are either 'made' or 'broken' by this single exit point.

This is not a unique situation that Michael finds himself in as the role of the end of year externally set matriculation examinations features prominently in South Africa on judging secondary schools on an annual basis. Media coverage is extensive as is rhetoric on how schools will be held accountable for results that are deemed unacceptable. Statistics for this examination are rife and are used to shape policy both in terms of resources and curriculum design. Schools with disadvantaged learners in terms of financial status that achieve significant pass rates are touted as national examples further adding pressure on educators to achieve despite the difficulties they may be encountering.

7.6.6.3 Content before Context

Michael's solution to resolving the problem of a curriculum that is 'too long' is to place emphasis on the content and then to use context only and to the degree that instructional time permits. This practice is distinctly in dispute with the curriculum statement that claims (Doe, 2003:42):

The approach that needs to be adopted in developing Mathematical Literacy is to engage with contexts rather than applying Mathematics already learned to the context. Research done internationally and in South Africa confirms this approach for young people as well as for adults.

Mathematical Literacy requires the teaching of 'mathematics in context', and as such Michael's compromise raises the following questions: If Michael had a deeper understanding of the pedagogy required to teach mathematical literacy would he be able to find an alternate compromise, to the problem of time, that would not go against the curriculum intentions? Why does Michael not have this deeper understanding? How does this 'compromise' affect the implementation of mathematical literacy in his classroom? Does Michael make any further compromises?

7.6.6.4 Learner Ability

Michael: The length of the curriculum would not be a problem if the pupils taking the subject had some ability in mathematics, even an average ability. But you must remember most of these pupils never passed mathematics in grade nine, some have never passed mathematics as far back as primary school. Now we are expected to teach them grade ten work and pretend that their past does not matter. Of course it matters. I have pupils in my class who do not know how to use a calculator; some do not even understand what a negative number is. If you do not start with the basics what are you going to build on?

Continuing he added:

To make matters worse, these pupils do not believe that they have the ability to pass maths. As soon as they see an equation they switch off immediately. It also does not help, that they feel stupider than the pupils doing mathematics.

Students doing mathematical literacy at FET High School have academic records that indicate a poor history of mathematics achievement. Michael's struggle to complete the curriculum is, as he has expressed, not only because of the actual curriculum design but also as a result of the cohort of learners taking the subject. His articulated opinion is that the design in terms of length is appropriate for students that have a past indicative of at least an average ability in mathematics, which is not the ability of the learners that he finds he has to teach.

Building a foundation on which to structure mathematical literacy is imperative; however the question remains as to whether this foundation cannot be positioned in a way that is aligned to the curriculum document? The positioning of which may require relinquishing past beliefs and pedagogy that are entrenched in Michael's instructional practice and a redefining of his beliefs and understanding on the 'nature of teaching mathematical literacy'. The deep changes required are not necessarily the solutions to the problems but unless they take place the curriculum success can not be ascertained unless it is implemented as intended.

With so much emphasis on the unacceptably low levels of mathematical literacy in South Africa this opportunity to implement a curriculum that attempts to address these levels should feature prominently and continuously in staff development programs. Michael has attended the workshop and read the curriculum document, and yet his command of the curriculum intentions is thin. He is unaware of having to attend further training and as such, at least for the time being, it can only but be assumed that unless an 'external force' intervenes, his understanding of the curriculum will become established at the level of his initial interpretation.

Having raised the issue of 'mathematics phobia', I proceeded to show Michael a short extract from the curriculum that acknowledged his retort. This extract is given below as is Michael's response to what I showed him:

Many local and international studies have shown the existence of a set of attitudes-described as 'math phobia'-in school-going learners and in the population at large. It is the responsibility of the teacher, in implementing this curriculum, to endeavor to win learners to Mathematics. Real-life contexts, which lend themselves to mathematical ways of thought, are ideal for doing this (DoE, 2003:43).

Michael: Always the responsibility of the teacher. What about the government's responsibility to the teachers? They come up with all these ideas and then leave us with the problem of making them succeed, without them asking us how they can help. Why don't they come into the classrooms and try to teach these pupils that have never passed mathematics? Let them try and finish the syllabus when the children

cannot even use a calculator, and then they would see the real difficulties we are faced with. I love the example they provide, yes I can see that using contexts will now out of the blue, after so many years make them love maths? It makes me sick, let's blame everything on the teachers, so that the politicians can sit back and say that they have done their job. Are they blind to how many qualified teachers have left the profession because of all the changes they have made?

Michael's outburst was surprising and contrary to his calm disposition that I had become accustomed to. It spoke of anger and an overwhelming sense of frustration at having to deal with repeated change and government sanctions. It is undeniable that the numerous changes in both curriculum documents and pedagogy have resulted in high levels of stress and frustration for many educators in South Africa. Statistics are commonly cited in the media as to the high number of educators leaving the profession and the low numbers of secondary school graduates entering the profession. This unbalance is even more momentous in subjects such as Mathematics and Physical Science. The difficulty Michael is encountering in educating learners that have a history of low levels of Mathematics achievement is to be expected as the subject was introduced as an alternative to Mathematics.

The expectation has been that the learners taking Mathematical Literacy, at least in the initial years, would be those that were not copying in the past with Mathematics. As such, it is confounding why the curriculum document does not provide guidelines, with any significant depth, on how the curriculum is to be implemented with students that have a history of learning difficulties, which can lead to 'mathsphobia'.

What is further as perplexing is why Michael does not refer to the documents that he was given at the mathematical literacy workshop. In one of these booklets in his possession, it can be seen that sessions were held during the workshop that dealt with the difficulties and problems that Michael had raised with regards to teaching students with mathematics difficulties. There was also a session and notes in overcoming and handling mathematics anxiety.

Despite all this, Michael had only taken away from this workshop an understanding and belief that he had the ability to teach the mathematics that was required of him in the mathematical literacy curriculum. It can then only be assumed that what Michael understood in this workshop is not what was been transmitted but what he, the receiver, required at that point in time. This for Michael was the need to believe that he had a command of the content of the new curriculum.

The implications of such deductions point towards designing staff development programs that stagger information transmission rather than overwhelming educators with new concepts and pedagogy at once off workshops. These deductions and the implications thereof will be analyzed and discussed in greater detail in Chapter Eight. I now proceed with the findings that pertained to the second research question.

7.7 How does Michael proceed to implement the mathematical literacy curriculum in his classroom?

Having provided a comprehensive discussion on how Michael understands the purpose, possibilities and problems of the new Mathematical Literacy curriculum I will now provide a similarly comprehensive discussion on how Michael proceeds to implement this curriculum.

The evidence for this was obtained from the following research instruments; Questionnaires (Schedules A&B), Classroom observation protocol (Schedule E), Document analysis schedule (Schedule F), casual conversations, and notes from the Researchers journal (Schedule J). The findings are portrayed within the frame of the second research question of this study, namely, how do teachers proceed to implement the mathematical literacy curriculum in their classrooms?

I will begin this section by providing Michael's claims with regards to his instructional practice while at the same time providing comparative analyses of his claims and understanding of the curriculum, as well as his claims and the intentions of the

curriculum. The section will then be concluded with a description of his observed classroom practice with discussion of the similarities and dissimilarities of his claims, understanding and the curriculum document.

7.7.1 Claimed Instructional Practice

Differentiating between what Michael claimed his instructional practice to be and understanding what his perception of what it should be is an important one as it provides a deeper perspicacity on his actual understanding of the curriculum. This is because Michael's practice may not reflect his understanding but rather the circumstances of the reality in which he teaches. As this study is about how educators understand a new curriculum this differentiation is necessitated.

Michael indicated that he strongly agreed, that the teaching of mathematical literacy was an opportunity for educators to 're-define their thinking about the nature and teaching of mathematics', that it should be 'taught with life-related applications' and that it was 'similar to the previous Standard Grade Mathematics curriculum in teaching'. He agreed that teaching should 'favor process of context and content over content' and that the nature of mathematical literacy is such that 'it improves your teaching'. These findings reveal one major discrepancy.

If Michael believes that the teaching of this curriculum requires a re-thinking of his instructional practice why does he also hold that it is similar to the teaching of the 'old' Standard Grade mathematics, which clearly favoured content over process? This incongruity may be as a result of his thin level of understanding of what teaching 'mathematics in context' necessitates, with particular reference to his admitted instructional style of teaching content before context. Additional evidence for this that further explicates his understanding is provided in the following explanation of Michael's:

The teaching of mathematical literacy is similar to teaching standard grade mathematics as you are similarly dealing with weaker pupils and less difficult mathematical concepts. The only difference is that in mathematical literacy you expose the pupils to real life applications, whereas in standard grade mathematics word problems were not even part of the syllabus.

His reference to word problems attaches some degree of synonymy between teaching mathematics in context and the aforesaid. This further illustrates how Michael understood the teaching of mathematics in context that is as similar to using word problems in mathematics. As this was only taught to Higher Grade pupils it may also further point towards why Michael avoids doing so. For the implication here would be, that if he believes that his students are mathematically weak, he will avoid teaching them 'mathematics' that was in the past restricted to the stronger higher grade pupils, as this may be at odds with the mathematical expectations he has of his students, which the literature claims should be high for effective mathematical literacy instruction.

The literature asserts that effective mathematical literacy teachers possess certain traits and behaviors, and these were put forward in the questionnaire. Michael specified that he strongly agreed that these should include 'promoting and valuing learner effort', and that educators of this learning area should be 'confident in their own knowledge and skills'. He further agreed, that effective educators should have 'high but realistic expectations of all learners', that 'both teaching and learning should be enjoyable', and that the mathematical focus should not be lost in the context but made clear to the learners. His response of what traits are required of effective mathematical literacy educators' shows an understanding aligned with literature in this domain.

Michael also claimed that his instructional practice at the time of the research mirrored the following statements:

- sensitive to indigenous knowledge systems,
- engaged real-world problems,
- integrated lessons with other disciplines,
- engaged learners both critically and creatively,

- made use of technology,
- allowed for reflection,
- feedback and assessment was integrated with teaching,
- process and context favored content,
- educator is confident,
- educator is motivated.

What was out of the ordinary was not that he had responded in a way that showed a deep understanding of the intended curriculum, but that of the twenty four questions he had only provided a response to the ten listed above. I questioned Michael on why he had not included a response for the rest. Taking the questionnaire back from me and looking at what he had marked Michael replied:

If you take for example point nine,' high levels of numerical skill are afforded' to say that there is room for improvement would imply that I am looking to change this, but the truth is I will not. As I have said there is no time. I suppose that I could have ticked it does not mirror the statement but the point I am trying to make is that I know that my teaching should mirror all these statements but I simply just do not have the time. Not with such weak pupils, my focus is to build the basics.

His response echoed with his understanding of mathematical literacy as mathematics content. The high level skills that are required by the curriculum, for Michael implied more mathematics. As such he focused his teaching on building basic mathematics concepts for he felt he did not have time to extend the pupils beyond the basics.

Combining the findings, up to this point, show Michael's claims about his instructional practice to be similar to his understanding of the intentions of the curriculum document. Mainly, that Michael holds a surface level understanding of the required pedagogy and purpose as intended by the curriculum document. What is also evident is that Michael does not question his understanding but rather supports the problems he is faced with, with justifications on learner ability.

Inconsistencies scattered throughout his responses are also further explained away by Michael, as knowing what to do but not been able to do so, again listing the justifications

already mentioned. It is pertinent to note that the 'problems' that Michael claimed he was experiencing in implementing the curriculum were all about the students and at no time did he express any of these to be associated with his actual understanding of the curriculum. Once again this point is critical, for if we are to assume that Michael's understanding of the curriculum requires greater depth then we must assume that this can only take place if Michael becomes aware of his thin understanding. The question that then arises is how and why will Michael become aware of this, having already both read the curriculum document and attended the Mathematical Literacy workshop?

The evidence acquired from the interviews and questionnaires showed that Michael's perceptions and understanding of the Mathematical Literacy curriculum varied considerably. There were continuities, discontinuities, confusion and contradiction. Where his understanding was aligned with the document, this seemingly was only on a surface level. The classroom observations will provide the necessary evidence that will either refute these findings or further validate them. What is more, it will provide for a more holistic interpretation on how mathematical literacy is actually being implemented in Michael's classroom, given his current understanding of the curriculum.

7.7.2 Observed Instructional Practice

Grade 10C, which is one of the classes that Michael teaches mathematical literacy to, was observed over a period of five weeks, which constituted forty-two thirty-minute periods. The follow up week, which formed part of the initial design, was not conducted as Michael fell ill and was absent from FET High School for eleven days. We were unable to reschedule this for when Michael did return to school, the students were writing end of year examinations.

The lessons are described and depicted below, mostly in their entirety. This is not only done so to emphasise the lesson content but also the discourse that was taking place in Michael's classroom. This format, I believe lends itself to the exploratory design of this

study as it captures the essence of the instructional delivery of a brand new curriculum in Michael's classroom.

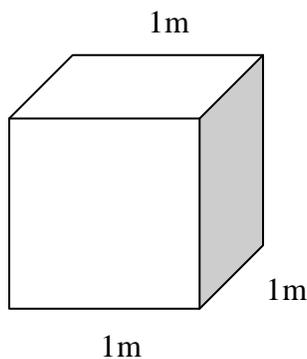
7.7.2.1 Observed Lesson: One

Thirty-two learners arrived to Michael's classroom punctiliously. They were neatly dressed in gray flannels, school tie, black school shoes and white shirts. Many wore the school jersey with a handful in the school blazer which had the school crest and motto sewn on the left breast pocket. The learners stood until Michael greeted them and then asked them to sit down. Michael proceeded to introduce me and spend a few minutes explaining to the learners why I was there. It was interesting to listen to what Michael had to say, stressing several times that I was not there to assess him or the students but only to observe. Once the explanation was over Michael began his lesson by writing on the board, which he interspersed with several explanations:

Surface Area and Volume

$$1\text{l}=1000\text{cm}^3 \quad 1\text{ml}=1\text{cm}^3 \quad 1000\text{l}=\text{m}^3$$

Mr. Michaels: *With units of volume it is important to be able to do conversions. What this basically means is, well let me show you. If you recall volume is equal to length times breadth times height.*



Mr. Michaels: *Use this relationship and find the following units. You have done proportion earlier on. If you find it difficult discuss with the person next to you.*

Convert the units of the area below to the units in brackets.

a) $1m^3 = \dots cm^3$

b) $1km^3 = \dots m^3$

c) $1mm^3 = \dots cm^3$

The learners, without any sound, took out their books and began to copy down the work. After a couple of minutes Michael started to walk around the classroom answering various questions that the learners had. Many struggled and it was evident that the majority had no idea how to begin the very first question. Michael returned to the board, asked the learners to pay attention, and began to write, reading what he was writing.

$$1m=100cm$$

$$1km=1000m$$

$$1cm=10mm$$

Mr. Michaels: Remember this guys, we did it last week. You need to learn these relationships otherwise you will not be able to do the conversions.

Michael spent the remainder of the lesson answering questions that the students had. Near the end of the lesson he asked them to take out their textbooks and referred them to an exercise for homework. He asked if any of them required a calculator, which he then handed to all the learners that indicated in the affirmative. This was the end of the lesson and the end of a Friday afternoon school day. Once the learners had left I sat down with Michael to conduct the first post-lesson interview, in order to ascertain on why he had conducted this lesson and how he felt the lesson had been received by his students.

Interviewer: *What was the purpose of this lesson?*

Michael: *We are busy with area and volume, and today I wanted them to use the linear conversions that they had done in determining volume. I drew a cube because for those who struggle, if they remember to place the converted units on the sides of the cube all they need to do is multiply them out. This visual I find helps a lot.*

Interviewer: *In your view was this a successful lesson?*

Michael: *Yes, definitely. I gave them all the basics that they require. If they learn these they can apply the maths to any example.*

Interviewer: *Do you believe that the pupils acquired the skills and knowledge you expected of them before the lesson?*

Michael: *The one's that go home and learn the work, definitely. But it is important to learn the relationships off by heart. How can they do conversions if they do not know that one-centimeter is equal to ten millimeters?*

Interviewer: *In future would you do anything differently?*

Michael: *No, why, do you think I should?*

Observed lesson one was entirely focused on content. Having admitted that he always taught content before context this was to be expected. However, what was not expected was the homework that Michael had chosen for the learners, which was as devoid of context as was the lesson. The questions in the textbook that embedded conversions or allowed for their application were ignored in favor of the more straightforward and abstract mathematics conversions. Michael however was satisfied with how he had taught the lesson and believed that the students would acquire the necessary skills and knowledge if they learnt the 'linear' conversions by rote.

The next five lessons observed continued to deal with this learning outcome in an identical manner. Equations and formulas were continuously given and other than sterile diagrams of right prisms there was no engagement with any context let alone context of relevance to the learners. The two assessment standards that relate to this outcome of

Space, Shape and Measurement were completely covered in terms of mathematical content. The Theorem of Pythagoras was taught, areas were calculated, conversions were explained, and formulae for volumes of prisms were given. Michael had claimed that once he had taught the content he would, if time allowed, use what was taught and apply it to various contexts. In this section of work, Michaels' claim did not materialize. What did was his focus on the actual mathematics which he prioritized over all other requirements of the curriculum.

Within the first three lessons Michael's blueprint of instructional practice became clearly visible. Lessons would either begin with the marking of homework or an exercise continued from the previous day. The mathematics content for the particular day's lesson would then be placed on the board, explained and the instruction given to copy it down. The textbook would then be referred to and class work exercises and homework would be set. Perhaps this would change if he were to introduce a new learning outcome?

7.7.2.2 Observed Lesson: Seven

Having completed the section that he had been busy on over the past six lessons I looked forward to observing a lesson that required the introduction of Learning Outcome Four: Data Handling, to which Michael had responded with enthusiasm and a relatively deep understanding during the interviews. His lesson unfolded as follows:

Mr. Michaels: Today we will be starting with a section which you need to write a main heading, called Data Handling. Please copy down the following transparency:

Data Handling

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Case	200	75	500	1500	775	1125	1000	800	1250	1200	600

a) In which year was the number of flu cases the highest?

- b) In which year was the number of flu cases the least?
- c) Between which years was this increase the highest?
- d) Between which years was there a decrease in flu cases?
- e) How many cases of flu were recorded for 1990 to 2000?
- f) The population for the district was 1800, 10000 and 7000 in 1993, 1998 and 2000 respectively. What % of the population had the flu in these years?

Mr. Michaels: *I would like you now to divide yourselves up in groups of three and answer the questions.*

Within minutes the students arranged themselves in groups and proceeded with the task that had been assigned to them. Michael involved himself no further in the lesson and sat at his desk marking the Grade Eleven cycle test that one of his classes had written earlier on in the day. The post-lesson interview revealed that Michael was very pleased with his teaching of mathematical literacy to Grade 10C for the day:

Interviewer: *What was the purpose of this lesson?*

Michael: *To show the pupils how to interpret data that is represented in tables. We began with basics, like which is the highest and which is the lowest, what is the difference, calculations like this. When they work all these out then they can see the meaning in the information. Without the comparisons this is all lost.*

Interviewer: *In your view was this a successful lesson?*

Michael: *I thought I would start with something really basic. In this way the pupils could enjoy the work and realize that this section is really easy. They did not come to my desk with questions, so I am sure when we mark this work they will have got most of it right.*

Interviewer: *Do you believe that the pupils acquired the skills and knowledge you expected of them before the lesson?*

Michael: *Yes, they had to analyze data in the table that helps them to interpret data in any other tables. With statistics on AIDS always in the*

headlines, they can use these skills to understand this growing epidemic in our country.

Interviewer: *In future would you do anything differently?*

Michael: *I would like to look for other examples in newspapers or magazines that show AIDS statistics. I think that this is important.*

Learning Outcome 4, as previously described, stipulates that 'the learner is able to collect, summarize, display and analyze data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions' (DoE, 2003:34). Of these competencies only an analyses in terms of knowledge given was observed to apply to Michael's first lesson. The next two weeks of observed lessons showed no further engagement with any of the other skills, values or use of contexts that as indicated above he continued to say he needed to include in his lessons.

In the post lesson interviews it was also often made mention of the importance of comparison and yet discussions pertaining to comparative data were absent from the lessons. What is more is that it was found that Michael clearly regarded his lessons as successful and akin to the curriculum provisions. The observations made of his practice were not only far removed from the curriculum intentions but were also divergent from his claimed instructional practice. It became apparent that not only his thin level of understanding of teaching 'mathematics in context' impacted on his lesson instruction, but also his revered superiority of 'naked' mathematics. For Michael, a successful lesson entailed teaching the mathematical knowledge that the actual calculations entailed, believing that the students could then apply these to any other contexts that might arise.

His 'blue-print' of instruction was broken in observed lesson eleven.

7.7.2.3 Observed Lesson: Eleven

Michael began this lesson slightly different to the procedure of all previous lessons as he did not write the days exercises on the chalkboard but handed out a worksheet. He was

still teaching Data Handling and had prepared a worksheet with three questions. This was handed out to them and they were told that it was to be returned to him at the end of the lesson in order for the work to be assessed. The learners were allowed to work in pairs but had to hand in individual work. The worksheet has been reproduced below in order to preface the discussion that follows with respect to the observations made of Michael's understanding of the curriculum requirements.

FET High School

Grade 10

Mathematical Literacy

Instructions: Answer All Questions

Question 1

Fanelwa receives the following results on homework assignments: 85,71,87,72 and 79. Nomphele received 65,99,86,90 and 51 for the same assignments.

a) Find the mean and range of Fanelwa's homework assignment results. (4)

b) Find the mean and range of Nomphele's homework assignment results. (4)

Question 2

The following table gives the values of Jana's body temperature taken at different times during a day:

Time	04:00	08:00	12:00	16:00	20:00	24:00
Temperature (degrees C)	36,2	36,4	36,9	36,9	36,8	36,5

a) Find Jana's mean temperature for the day. (2)

b) What is the range of body temperature throughout the day? (2)

Question 3

At eight soccer matches the number of spectators present was:

873 681 752 942 621 826 1 036 1 092

a) Determine the median number of spectators at the matches. (2)

b) What is the range in the number of spectators at these matches? (2)



The lesson ended with the students handing in their worksheets. At the end of the school day, as had become common practice I asked him about the day's lesson:

Interviewer: *What was the purpose of this lesson?*

Michael: *To use the mathematics taught in contexts that are of relevance to the learners. The World Cup Soccer in 2010 allows for many such opportunities and the pupils are all soccer mad.*

Interviewer: *In your view was this a successful lesson?*

Michael: *Yes, I think so. You saw, they loved it. They spoke about the soccer non-stop. Also the body temperature, now they can go and discuss this in Biology.*

Interviewer: *Do you believe that the pupils acquired the skills and knowledge you expected of them before the lesson?*

Michael: *Mean, range and median have all been taught. Today the pupils were shown how these could be used in examples that are relevant to their daily lives. They are no longer abstract concepts.*

Interviewer: *In future would you do anything differently?*

Michael: *Seeing how much they liked the soccer question, I will find more examples dealing with soccer.*

The truth was that the learners had enjoyed the lesson. After several minutes into the worksheet it took one learner asking Mr. Michaels who he would be supporting in the 2010 World Cup Soccer for the entire classroom to view this as an invitation to start what became a very lively discussion. Michael's claim that the instructional practice should be enjoyable clearly mattered as it surfaced not only in the pleasure it seemed to give him in engaging the learners in the lively soccer debate but also with the enthusiasm he showed in his responses during the post lesson interview.

What is more pertinent to this study however is that the lesson had not met the curriculum demands outside the scope of actual mathematical calculations. The assessment standard curriculum requirements are: 'Calculate and use appropriate measures of central tendency and spread to make comparisons and draw conclusions, inclusive of the: mean, median, mode, range' (DoE, 2003:34). Of this requirement Michael's worksheet had only covered

the 'calculation' assessment standard. There was no discussion about the 'central spread' or comparison of any of the data, which clearly lend them to such discourse, particularly in question one.

His superficial understanding of the teaching of mathematics in context was further more evident than ever, in his use of a picture of a soccer player, which was representative of the context. This 'dressing-up' of the content with pictorial representations of context was also evident in some of his assessment tasks that I looked at. These are discussed in a later section below.

Michael had also claimed that his instructional practice integrated other learning areas. What can be deduced from this lesson is that Michael did not make this claim falsely; however it appeared to also be predisposed to his thin level of understanding of 'mathematics in context'.

Question two had an authentic use of context; however Michael did not take the opportunity to allow his students to explore this any further. The average human body temperature was not given and as such no standard of comparison could be made. Also there was no discussion on why the body temperature varied throughout the day and the significance of these fluctuations on Jana's well being. The curriculum requirement that data handling be engaged with critically, 'especially in the manner in which these are encountered in the media and in presenting arguments' was met with no sizeable correlation (Doe, 2003:11).

Of the twenty-one lessons observed, I have depicted the lessons that included teaching 'mathematics in context' to the largest degree. Having claimed that the only change that Michael had made to his instructional practice was the application of content taught to various contexts I observed eight of his Grade 11 Mathematics lessons. These observations revealed findings that attested to his claim, in that none of them supported any reference of application to context in any of the mathematics that was been taught.

This complete absence of application supported why Michael held the perception that his mathematical literacy instructional practice was different to that of his Mathematics instruction. Michael had made changes, however given that his starting point was so far removed from the mathematical literacy requirements these changes were only significant to Michael and not to the actual implementation of the mathematical literacy curriculum as intended.

What also featured prominently in these eight Mathematics lessons observed was Michael's attitude and expectations of the learners. In his Mathematical Literacy classes Michael was guarded against his interaction with the learners, and with the exception of the lively soccer discussion, which had no mathematical relevance, there was little if any 'teacher-pupil' interaction, providing in most cases the solutions to the learners before eliciting their responses. In his Mathematics lessons, Michael was by far more relaxed in his interaction with the learners and allowed for various discussions and debates on differing solutions. Furthermore in six of the eight lessons he challenged the learners with a 'difficult' mathematical problem during the lesson. Such challenges were never forthcoming in any of the twenty-one mathematical literacy lessons observed.

Michael's differentiation in teaching and interacting with a class according to perceived ability was clearly evident. Why did the learner ability affect his instructional practice?

Synthesis of the lesson observations yielded the following deductions with regards to Michael's Mathematical Literacy instructional practice:

- no ownership of the curriculum,
- mathematical content was not only the focal point but predominantly the lesson,
- lessons were not sensitive to broader societal concerns,
- teacher-centered,
- attitude towards learners was guarded,

- recognition was not provided,
- no critical analyses of data or engagement with mathematical arguments,
- no use of indigenous mathematics contexts,
- creativity in solving problems was not allowed for let alone encouraged,
- instructional expectations of learners were low,
- surface teaching of mathematical 'life skills',
- contexts used were as chosen by textbook authors,
- instructional practice was based on a blueprint of years of experience.

These observations reveal that not only are Michael's understandings of the curriculum at a surface level but also that his instructional practice manifests itself at an even thinner level. His understanding of context is a superficial band-aid on mathematical content that allows him to perceive his teaching practice as both significantly different to his mathematics instruction and aligned with the curriculum document. This change has already established Michael's belief that he is implementing Mathematical Literacy in the way that is required. As such Michael does not question his practice nor seek intervention to change it any further. This raises two imperative questions pertaining to this study. How will Michael move from this surface understanding to a deeper level of understanding in the absence of a reflective instructional practice? What will allow for the reflection needed and thus for the deeper change required?

During the classroom observation time, I also looked at student workbooks and other documents relating to Michael's teaching of mathematical literacy. These were evidenced as follows:

7.7.3 Learner Work Books

Michael's mathematical literacy students work in hard covered books that are used to take down the daily lessons and complete their homework therein. These are studiously

brought to every lesson and handed in every second week to be marked. Marking is done on an acknowledgement level indicating that the work has been done and there is no indication that work is corrected in any way.

With the exception of several pictures on worksheets that are pasted in the learner workbooks there is little other evidence of any use of context. Page after page is filled with formulae and mathematical calculations. The Data Handling section is thin on real life contexts that Michael claimed he would use in this section of his instructional practice. The work done on 'Number and Operations in Context' also had as its focus mathematical content and barring various calculations and manipulations of the compound interest formulae there are no authentic contexts in terms of application.

These two sections were the two that Michael expressed to believing could afford the learners with opportunities in engaging mathematics in contexts of relevance to their daily lives. Why had Michael not seized this opportunity to afford his students not only mathematical knowledge but skills and values that would benefit their lives in the way that he believed these learning outcomes could?

7.7.4 Use of Technology

In the questionnaire Michael had indicated that he always used scientific calculators, sometimes used spreadsheets and often used unspecified computer software. His observed instructional practice and evidence from the learner work books only validated his claim of often using a scientific calculator .The curriculum specifications include the use of computational tools taking a scientific calculator as a minimum but suggesting that 'where possible, learners should have the opportunity to use spreadsheets and other computer tools' (DoE, 2003:12). Such tools were not only available to Michael, but as was evidenced by his mark book, which was *Excel*, Spreadsheets Michael had the skills and knowledge to teach mathematical literacy using these tools. His response below defends the finding that Michael's' expectations of his learners were not analogous with the curriculum expectations of instruction providing for 'high knowledge and skills':

*Perhaps next year I will take them into the computer room, for now we have to rather spend the limited time we have on using the calculator. These pupils struggle with doing basic operations on the calculator, how will they ever cope with learning to do a spreadsheet?
He added:*

Not even the other mathematics teachers can do spreadsheet, but I am known as the Mathematical Literacy teacher. This is why I have to leave.

It can only be assumed that Michael's responses on the questionnaire were an indication of his computer abilities and not those that he understood were required or necessary to be taught to his students. This was not because he believed that computer skills were not a necessity but because he believed that they were beyond his current students' ability. This behavior restricted his students from acquiring the necessary knowledge and skills that the curriculum allowed for.

His drifting from discussing computer skills to his retort on being known as the mathematical literacy teacher digs deep into Michael's perception of how mathematical literacy defines him as an educator. A revelation, that was not in the lines of inquiry in the propositions of this study, but kept manifesting throughout the duration of both the case studies and the snap shot interviews. The impact of wearing the 'Mathematical Literacy Educator' label on the implementation pathway of this curriculum may go far in explaining why the emphasis is on content and not on the process of content and context. Michael venerates mathematical content, the surrendering of, which may be perceived as a compromise to his 'status-identity' as a Mathematics educator. The veneration of 'naked' mathematics over 'mathematics in context' was also evident in Michael's assessment practice.

7.7.5 Assessment

Rating scales on the tests and worksheets were all of traditional marking and gave a numerical result out of the possible marks obtainable. The new rating codes and their relevant descriptors of competence were only reflected on the learners' reports and not on any of the assessed worksheets or tests. Rubrics were also absent and although

collectively this evidence reflects more on Michael's instructional non-transformation to Outcomes Based Education it also go towards his understanding of the Mathematical Literacy curriculum.

The curriculum document states that, ' rubrics require teachers to know exactly what is required by the outcome' (DoE, 2003:50) and as such the absence of engagement with designing rubrics robs Michael of a deeper understanding of the curriculum possibilities and as such purpose. The implications of this are limited opportunities in understanding and thus delivering the curriculum as per design.

The assessment tasks in the learner workbooks were also similar to his classroom instruction as to what was expected as an end product-accuracy of mathematical answers. The process of arriving at an answer was neither valued nor recognized. Pictorial depictions substituted for contexts, and application of knowledge and skills was at a level of routine procedure, with no evidence of complex procedure in neither application nor problem solving. These findings are discontinuous with those stipulated in the curriculum document and also with Michael's claims. Why Michael proceeds to implement the curriculum in this way forms the next section of this chapter.

7.8 Why does Michael implement the Mathematical Literacy curriculum in the way that he does?

Having portrayed Michael's understanding of the curriculum document and his observed instructional practice I will now provide evidence of what seems to shape and define his practice in pursuit of providing an explanation for the third research question to this study, namely, why do teachers implement this curriculum in the ways they do? In other words, what explains the implementation pathways followed by the mathematical literacy curriculum in real classroom contexts? The evidence for the response to this research question is obtained from the following research instruments; the Interview Schedules (Schedule C&D), Questionnaire Schedule (Schedule B), Document Analysis (Schedule F) and the Researchers Journal (Schedule J).

I begin this line of inquiry by evidencing the documents and records in Michael's possession.

7.8.1 Educator Documents and Records

Michael had in his possession copies of the Mathematical Literacy curriculum, the Assessment Guidelines, two Mathematical Literacy textbooks, the notes from the Mathematical Literacy workshop that he had attended, and a copy of an exemplar paper that he had downloaded from a departmental affiliated website-thutong.org.za An analysis of the textbooks and the exemplar paper revealed a high correlation with the curriculum design, particularly with regard to the use of context required in mathematical literacy pedagogy. The exemplar paper was also found to be in line with the Assessment Guidelines for Mathematical Literacy and the Assessment chapter in the actual curriculum document.

7.8.1.1 Mathematical Literacy Curriculum

Michael had indicated that he had read the curriculum document and had understood it to a large extent. Five weeks of observation revealed this claim to be limited to Chapter 3: Learning Outcomes Assessment Standards, Content and Context. What is more, is that even though Michael did refer to this part of the curriculum he focused mainly on the content. His concern was in whether he had covered all the necessary mathematics and showed little interest in any of the 'verbs', which represented the required competencies for the various learning outcomes. The section, in the same chapter, entitled Content and Contexts for the Attainment of Assessment Standards was also not referred to. Michael's perception was that if he taught the mathematics the students would be able to apply it to contexts that required it:

We cannot loose focus of the mathematics, the application will follow. In life this will vary, so it is so much more important to teach the pupils how to use formulae and equations so that they are not scared of numbers. If you look at the two textbooks you will see that the examples

are different and I am sure that other textbooks would also have other examples but the mathematics required remains the same. It is this ability that will allow them to cope with subjects requiring mathematics at tertiary level. My focus is on the mathematics as prescribed by the curriculum, this is what is important and necessary.

Michael's perspective on valuing 'Pure Mathematics' over 'mathematics in context' is favored by extensive literature²⁸ that argues against the use of real-life contexts that originate from the lived experiences of 'underprivileged' learners. Though, there is no evidence to claim that Michael's beliefs and understandings of the choice of context or the lack thereof is influenced in any way by this literature his inherent reverence of 'naked mathematics' significantly impacts on his instructional practice.

He is not delivering the mathematical literacy curriculum in the way that he does because he does not understand that he should be using contexts, he is delivering it in this way because he is consciously choosing content over context. Michael is doing this because of the value that he attaches to 'pure' mathematics. And, even though, this study is not an inquiry into the socio-economic utility of Mathematical Literacy in South Africa it is important to note that the interpretation thereof in terms of 'value' is appreciably influencing the implementation pathway of this curriculum in Michael's classroom.

7.8.1.2 Text Books

The use of the textbook, by Michael, in his teaching practice was not only extensive but often the sole source of instructional material. It was clear that he did not question the content of the textbook and used it not only in his daily teaching but also to vindicate him when challenged on what he was teaching. The following interaction with one of his learners, from observed lesson twenty, provides evidence of his dedication to the textbook teachings:

Boy Learner: Sir, this question is too difficult. My friend from the Mathematics class could not even help me. Are you sure it is in the syllabus?

²⁸ See Dowling, P (1998) and Muller, J. (2000).

Mr. Michaels: *It is not difficult; you just cannot do it. If your friend can also not do it then maybe he should also be in this class. Hands up, if you also found it difficult.*

(Class does not respond.)

Mr. Michaels: *You see, maybe you and you friend should be in a special class of your own.*

(Walks up to researcher with textbook in hand pointing at the said question, and announces loudly :)

Mr. Michaels: *This question is straight from a Grade 10 Mathematical Literacy textbook that you do not have. These people that write these textbooks know what they are doing, maybe your friend should write a textbook.*

This altercation with the learner does not only evidence Michael's allegiance to the textbook but also his attitude with regards to student's individual needs. Having acknowledged an awareness of 'math phobia' it is perplexing why he, more than likely, unconsciously chose to perpetuate it.

Michael's defense of the textbook would have also made more sense if he had selected the use of this over numerous others that were already available in the schools library at the time of this study. However, this was not the case. The textbook he mostly used (textbook one), which was also assigned to the students, was the first mathematical literacy textbook that the school had received as a sample copy from the publishers. His second textbook was similarly a free sample copy that had been distributed to FET High School. Further sample copies that were sent by the publishers were also available in the library. These had never been 'checked-out' as indicated by the computer records of the librarian. The reason for this was as Michael explained because the mathematics was the same in all the textbooks, but the use of context was not. As his focus was the mathematical content, he did not need to use the other textbooks as they could only provide further contexts, which he believed that the students who had learnt and understood the mathematics which he had taught would be able to apply these to differing contexts.

Although the textbooks had not been chosen, Michael did make choices as to what he was going to teach from them. Each chapter from 'textbook one' began with an introduction of the importance of the mathematics content that it dealt with in real-life application. The introductory examples were also predominantly 'mini-investigations' that integrated the content with the context. Michael, without fail, stripped the mathematics from the given contexts in both his explanations and lesson delivery. His instructional practice deviated from the curriculum in this main regard due to his reverence of the value of 'pure' mathematics.

7.8.1.3 Workshop Notes

Michael had two ring bound books with notes from the mathematical literacy workshop that he had attended earlier on in the year, the one dealt with the methodology of mathematical literacy and the other with exemplar questions. These were comprehensive documents that not only provided supplementary notes on the curriculum but also had extensive interactive exercises that allowed the delegates to engage with the curriculum on a relatively deep level. The activities in the notebooks had spaces in which the educators could record answers and perceptions. Several of the questions were pertinent to this study.

Michael in these spaces captured notes that showed a sizeable understanding of contexts relevant to everyday life. What was absent however in both Michael's and the workshop notes was coverage of how mathematical literacy was to be taught in terms of integrating content with context and not applying content learnt to contexts.

The exemplar tasks in the workbooks were also all contextually bound but again with no explicit provision that the teaching of mathematics should not precede its introduction into context, a stipulation of the curriculum, which can be found on several pages of the official document. An assumption is that this was implied.

However given that the nature of instruction for mathematical literacy is so distinctly different from that required in mathematics it would be expected that this would have formed a significant part in the workshop. Although it cannot be judged that the workshop that Michael had attended gave rise to Michael's surface understanding of teaching 'mathematics in context' it can be said that it had done little to contest this understanding. Having indicated that he had not found the workshop important, it was not surprising to find that Michael never referred to these notes. It begs the question that even if he did would the pedagogy required necessarily surface?

7.8.1.4 Exemplar Paper

Scrutiny of the exemplar paper that Michael had downloaded from the *Thutong* website revealed an assessment tool that was strongly aligned with the requirements of the curriculum. The questions were all contextually based, several in a South African context, and many relating to real life problems like obesity and budgets. The mathematical processes required in answering the questions required more than just the skill of doing mathematics, as some of the answers required critical interpretation and comparison. Michael valued this paper and indicated that he would be using it as the Grade Ten end of year examination.

I have a copy of the exemplar paper with its solutions, which is the best thing that the education department could have done. It shows what we should be teaching and how long the paper must be. I have looked at it and I am going to use it as the end of year examination .I do not need to worry about setting the paper at a standard that is too high or too low. If the pupils complain I will show them that this is what the government expects. One less paper to worry about.

However the value he had ascribed to this paper was not as a result of his own analyses of the paper but rather that it was the example that the education department had made available to mathematical literacy teachers. This was evidenced in the fact that at the time of the study he had not worked through the exemplar paper as its memorandum had also been made available on the website. There was also no indication that he would be

looking to work through the paper at any later stage. Once again Michael had not taken an opportunity that he was presented with which would have allowed him an inquiry on his seemingly already set understanding of the mathematical literacy curriculum. The reason for this was once again embedded in his belief that he had understood the curriculum document and that he had already managed to implement this curriculum as was required.

How he had arrived at this understanding can only be based on his belief that he understood the mathematical content which he had to teach. This ability, he felt distinguished him from other teachers who had never before taught or learnt Mathematics of Finance and Statistics. Michael had been taught this as a student doing Additional Mathematics in his Grade Twelve year.

7.8.2 Introducing Mathematical Literacy to FET High School

As mathematical literacy was the mandatory alternative to core Mathematics, Michael's Principal and Head of Department followed the education department requirements by taking the decision that it would be offered at FET High School as from the beginning of 2006. Michael was told that he would be teaching two classes of Grade 10 Mathematical Literacy near the end of the previous academic year.

He was not involved in these discussions and was unaware as to why he was the only educator in his department told to teach this new subject. At that the time he was given the curriculum document and one of the sample Mathematical Literacy textbooks that the school had received which he subsequently proceeded to use as it was also the textbook that his student's made use of.

Michael admitted that he never took either home, and only began to read both the textbook and curriculum document once his first mathematical literacy class arrived. His lack of interaction with the subject prior to its implementation was a result of the low level of mathematics that Michael believed this curriculum to require. An understanding

he had arrived at because of the students that would be taking this subject. That is, students who either were failing mathematics in Grade Nine or were going to pursue tertiary careers that did not require core Mathematics.

Prior to the implementation of mathematical literacy at FET High School, Michael had had no other interaction with teachers on the topic of mathematical literacy. And, other than the workshop that Michael had attended, this lack of communicating about this new subject had continued, at least, into the first eight months of its introduction.

The weekly departmental meetings focused on the FET core Mathematics curriculum, as did the cluster meetings that Michael attended every three months. Mathematics was always the point of discussion Michael said, not because there was no opportunity to discuss mathematical literacy but because the other educators in his cluster also felt that "it was going as well as it could be considering how weak the pupils actually are".

7.9 Learner's Views

As this study had an explorative design I asked Michael for his permission to look into how his students were experiencing this new curriculum, as this could go towards providing tacit insights into his learners own views on their ability and engagement with mathematical literacy, which may be a result of mathematical instruction that they had been receiving.

Michael had no concerns with regards to my request and offered me twenty minutes of one of his lessons near the end of the research period to conduct an exploration on his students' views on mathematical literacy. The students received a single question, namely, how is Mathematical Literacy this year different to the mathematics of the past, and were told that it was optional as to whether they wanted to respond to it or not. Of the thirty-two learners all of them handed me a reply at the end of the lesson.

I provide a sample of these reactions that most pertain to this study in terms of Michael's responses, in order to further provide evidence for perhaps why he has come to understand his student abilities in the way that he does. Inevitably, these perceptions of Michael's inform his delivery and ultimately play a role in how Michael proceeds to implement mathematical literacy in his grade ten classroom.

7.9.1 Learner Transcriptions

It is different, last years Maths was very easy, and this year it is kind of difficult. It is a natural thing, some people can and others can't.

It is different, it seems so much harder, and I feel pressured because I no longer have the choice, as to whether or not I want it as a subject. The maths is supposed to be on a lower grade to normal maths. It is not, we are really struggling. What I want to do one day does not require all this frustration that maths is causing.

It is not helping me one bit. It is hard and I do not understand. I left Mathematics in order to have an idea of what maths is about. Now I am even more confused and scared of failing.

It is not real maths, but it is still difficult.

No use. Remove maths literacy because we do not understand.

It is supposed to be easy and straightforward. Some were born intelligent, our class was not.

It is the same, you do sums. It is more difficult than last year. Maybe you should ask the Mathematics class they are bright.

It is difficult and a waste of time. I would rather be in English; there I do not feel stupid.

It is so hard, this IS NOT FAIR. I am embarrassed to tell people that I find this lower grade subject hard.

It is hard but at least it teaches me to do finance calculations because I intend to become a Chartered accountant.

Some of us are bad in maths and this was supposed to be easier, it is NOT. I am so stressed because I will fail the year if I do not pass maths literacy. I will never pass, I am not natural at maths.

Of the thirty-two respondents there was not a single indication that the learners found the instructional practice of mathematical literacy different to the mathematics instruction that they had received in the past. For these learners the only difference worth mentioning was the level of difficulty. What is more their self-perception of their mathematical ability was not only low but of an emotionally self-degrading nature.

On reading the responses Michael showed no sensitivity to these poignant features and proceeded to remind me that these students had a past history of unsuccessful mathematical achievement. He also stipulated that this is one of the main reasons why he focuses only on the 'basics'. Michael's perceptions of who can and can not do mathematics seemed enshrined in the students past histories which he evidently believed could not be written in any different way in the future. This is an important finding to this study as it impacts on the level of delivery of Michael's instructional practice which ultimately affects the implementation of the curriculum as designed, that is, with its requirement of affording high levels of knowledge and skills.

7.10 Summation

To sum up Michael understood the Mathematical Literacy curriculum in terms of teaching mathematics and then, time permitting, applying the mathematics taught to textbook assigned contexts. He was also influenced strongly with what he perceived as low learner ability which he did not believe could be changed appreciably and as such focused on what he called "teaching the basics". This understanding was not only discontinuous with the curriculum objectives but was also of disturbing significance to his students.

Moreover, Michael implemented mathematical literacy in a way that was ingrained in his beliefs and practices about the nature of mathematics from the past. These included a reverence of 'naked' mathematics that expressively defined Michael as an educator. The

label of 'Mathematical Literacy Educator' seemingly threatened this identity and it can go towards comprehending why Michael did not want to relinquish nor question his traditional instructional practice. For by aligning it to the past he ensured that he was no 'less' of an educator than he had been as a Mathematics educator.

In Chapter Eight I will pursue theoretical and empirical explanations for the questions raised in both Chapters Six and Seven through the analytical lens of the conceptual framework provided for in Chapter Four.